National Institute of Environmental Health Sciences

A stochastic model for ecological systems with strong nonlinear response to environmental drivers: Application to two water-borne diseases

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Abstract:

Ecological systems with threshold behaviour show drastic shifts in population abundance or species diversity in response to small variation in critical parameters. Examples of threshold behaviour arise in resource competition theory, epidemiological theory and environmentally driven population dynamics, to name a few. Although expected from theory, thresholds may be difficult to detect in real datasets due to stochasticity, finite population size and confounding effects that soften the observed shifts and introduce variability in the data. Here, we propose a modelling framework for threshold responses to environmental drivers that allows for a flexible treatment of the transition between regimes, including variation in the sharpness of the transition and the variance of the response. The model assumes two underlying stochastic processes whose mixture determines the system's response. For environmentally driven systems, the mixture is a function of an environmental covariate and the response may exhibit strong nonlinearity. When applied to two datasets for water-borne diseases, the model was able to capture the effect of rainfall on the mean number of cases as well as the variance. A quantitative description of this kind of threshold behaviour is of more general application to predict the response of ecosystems and human health to climate change.

Source: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2705977

Resource Description

Communication: ☑

resource focus on research or methods on how to communicate or frame issues on climate change; surveys of attitudes, knowledge, beliefs about climate change

A focus of content

Communication Audience: ☑

audience to whom the resource is directed

Researcher

Exposure : ☑

weather or climate related pathway by which climate change affects health

Ecosystem Changes, Food/Water Quality, Precipitation

Food/Water Quality: Pathogen

Geographic Feature: ☑

resource focuses on specific type of geography

Freshwater, Ocean/Coastal, Tropical

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Asia, Central/South America

Asian Region/Country: Other Asian Country

Other Asian Country: Bangladesh

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Infectious Disease

Infectious Disease: Foodborne/Waterborne Disease

Foodborne/Waterborne Disease: Cholera, Leptospirosis

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Outcome Change Prediction

Resource Type: ☑

format or standard characteristic of resource

Research Article, Research Article

Timescale: ☑

time period studied

Time Scale Unspecified

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content